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**PROGRESS REPORT**  
**ON THE**  
**GROUND-WATER SUPPLY**  
**OF**  
**PORTALES VALLEY, NEW MEXICO**  
**1938 - 1941**

By  
C. S. CONOVER AND P. D. AKIN

**GEOLOGICAL SURVEY**  
**UNITED STATES DEPARTMENT OF THE INTERIOR**

Prepared in Cooperation With the State Engineer  
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## PROGRESS REPORT ON THE GROUND-WATER SUPPLY OF THE PORTALES VALLEY, ROOSEVELT COUNTY, NEW MEXICO

C. S. CONOVER AND P. D. AKIN

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### INTRODUCTION

#### GENERAL FEATURES OF VALLEY

Portales Valley is a broad shallow depression in the Staked Plains in Roosevelt County, New Mexico, about 50 miles long and, in the vicinity of Portales about 30 miles wide, and extends east-southeastward from the west edge of the Staked Plain through Portales into Texas. The valley is characterized by gentle side slopes and by the absence of streams. Surface flows occur infrequently and only after heavy rainfall. There are many depressions and playas along the axis of the valley, some of which are occupied by ground-water lakes throughout the year, whereas others contain water only after periods of heavy rainfall. The perennial lakes are saline and are surrounded and, in places, connected by salt grass meadows. A strip of sand dunes extends along the north side of the valley for nearly its length and constitutes a favorable catchment area for precipitation. The surficial sediments of the valley average about 110 feet in thickness and consist of sand and silt with usually some gravel in the lower part. Relatively impermeable Triassic shales underlie these sediments.

The significant hydrologic features of the area have been summarized as follows<sup>1</sup>:

- (1) The underground drainage basin tributary to Portales Valley covers about 850 square miles.
- (2) The ground-water supply of this basin is all or nearly all furnished by the precipitation on the basin.
- (3) About 50,000 acre-feet of water was pumped from wells in Portales Valley in the period 1926-31.
- (4) The natural discharge from the valley by evaporation and transpiration amounts to about 7,500 acre-feet of water a year, most of which occurs below Portales.
- (5) The flow of ground-water down Portales Valley, past the vicinity of Portales, may amount to 24,000 acre-feet a year but is probably less.
- (6) Between 1910 and 1931, the water table had lowered appreciably, largely because of pumping, over an area of about 68 square miles, and had lowered more than 5 feet over 26 square miles of this area. The lowering of the water-table represented an unwatering of about 175,000 acre-feet of sediments.

1. Theis, C. V., Ground water in Curry and Roosevelt Counties, N. Mex.; New Mexico State Eng., (10th Bienn. Rept.), pp. 143-144, 1932.

## PREVIOUS WORK

An intensive investigation of the hydrology of the pumping area was made in 1931 by C. V. Theis, the results of which were published by the State Engineer<sup>2</sup>. Progress or continuation reports which gave supplemental basic information and data on amount of precipitation and pumping and changes in water level have been published<sup>3</sup>.

Complete records of water-level measurements in observation wells in Portales Valley from the beginning of record through 1941 are published or are to be published in U. S. Geological Survey Water-Supply Papers 845, 886, 911, and 941.

All work has been done under the general supervision of O. E. Meinzer, Geologist in Charge of the Division of Ground Water of the Geological Survey, and under the immediate supervision of Charles V. Theis. All work has been in cooperation with the State Engineer of New Mexico. Data for the years 1938, 1939, 1940, and part of 1941 were collected by C. S. Conover, who prepared a report covering the first two years, which is largely incorporated in the present report. Mr. Akin continued the collection of data after Mr. Conover left for military service and prepared the present report.

## CLIMATOLOGICAL DATA

Precipitation in Portales Valley affects the ground-water level both directly and indirectly. Rains during the winter months or moderate to heavy rains at any season contribute some water to the ground-water body by rainfall penetration and consequently directly cause a rise in water levels. Rainfall during the growing season causes a decrease in the amount of pumping and consequently retards the fall of water level due to pumping. If the rain comes late in the growing season the pumps are stopped early, and as a consequence the length of time for recovery, before the yearly measurements of water level are made in January, is longer than usual, and the water levels stand somewhat higher than usual.

The following tables give data on the precipitation as reported by the United States Weather Bureau. The first table gives the monthly precipitation from 1938 to 1941 for stations in and near Portales Valley. Portales is near the center of the irrigated area; Portales Evaporation Station is near the northwestern edge of the irrigated area, approximately 6 miles northwest of Portales; Clovis is near the north rim of the valley, about 18 miles northeast of Portales; Elida is on the south rim of the valley, about 25 miles southwest of Portales; Floyd is in the valley, about 12 miles west of Portales; and Melrose is on the north rim of the valley, about 25 miles west of Clovis.

2. Theis, C. V., *op. cit.*, pp. 98-160.

3. Theis, C. V., Progress report on the ground-water supply of the Portales Valley, N. Mex., New Mexico State Eng., 11th Bienn. Rept. pp. 87-108, 1934. Theis, C. V., *op. cit.*, (12th and 13th Bienn. Rept.) pp. 101-118, 1938.

## PRECIPITATION, IN INCHES, IN AND NEAR PORTALES VALLEY

1938	—Portales—		Portales				
	Precip.	Dep't.	Evap. Station	Clovis	Elida	Floyd	Melrose
January	0.60	+0.36	0.49	0.52	0.42	0.86	0.78
February	0.91	+0.53	0.83	0.95	1.34	0.78	0.52
March	1.00	+0.33	0.78	0.96	0.70	0.11	0.44
April	0.25	-1.13	0.00	T	0.41	0.23	0.08
May	0.27	-1.81	0.50	0.98	T	0.46	0.37
June	4.00	+1.31	3.61	3.45	2.18	2.76	1.35
July	2.92	+0.14	3.99	3.66	2.02	2.20	5.56
August	0.40	-2.34	0.07	1.23	0.07	0.13	-----
September	3.48	+1.20	2.46	3.46	3.46	2.30	-----
October	3.06	-1.73	4.57	5.00	2.53	4.70	-----
November	0.03	-0.77	0.00	0	0	T	-----
December	0.05	-0.65	0.00	0.11	0.28	0.04	-----
The Year	16.97		17.30	20.32	13.41	14.57	
Departure from normal		-1.10		+1.14	-2.93		

1939	—Portales—		Portales				
	Precip.	Dep't.	Evap. Station	Clovis	Elida	Floyd	Melrose
January	1.49	+1.25	1.63	1.94	0.65	0.94	1.19
February	0.20	-0.18	0	0.10	0.08	0.04	T
March	0.65	-0.02	0.76	0.54	0.67	0.66	0.81
April	0.98	-0.40	0.81	0.50	1.40	0.76	1.39
May	1.00	-1.08	3.03	2.11	1.01	1.83	3.07
June	2.88	+0.19	1.98	1.16	3.69	0.63	0.40
July	2.96	+0.18	1.40	0.90	2.54	2.45	1.79
August	3.24	+0.50	3.44	4.62	2.87	2.19	2.62
September	0.90	-1.38	0.71	0.28	0.22	1.12	0.39
October	1.04	-0.29	1.12	1.23	0.88	0.78	0.60
November	0.38	-0.42	0.42	0.33	0.23	0.26	0.33
December	1.17	+0.47	1.16	0.94	0.89	0.84	1.75
The year	16.89		16.46	14.65	15.13	12.50	14.34
Departure from normal		-1.18		-4.53	-1.21		

PRECIPITATION, IN INCHES, IN AND NEAR PORTALES VALLEY  
(Continued)

1940	—Portales—		Portales				
	Precip.	Dep't.	Evap. Station	Clovis	Elida	Floyd	Melrose
January	0.36	+0.12	0.12	0.26	0.21	0.26	0.04
February	0.35	-0.03	0.27	0.31	0.25	0.39	0.67
March	T	-0.67	0.00	T	0.00	0.00	0.00
April	1.50	+0.12	1.05	0.95	1.60	1.33	1.25
May	2.58	+0.50	2.12	2.62	1.75	2.37	1.63
June	1.02	-1.67	1.00	1.01	2.36	0.47	0.40
July	1.03	-1.75	1.51	0.45	1.56	0.45	0.16
August	1.63	-1.11	1.99	1.51	1.75	2.34	2.84
September	0.33	-1.95	0.16	0.48	0.25	1.09	0.73
October	0.63	-0.70	0.25	0.86	1.54	0.13	0.27
November	1.87	+1.07	1.43	1.76	0.93	0.90	0.70
December	0.03	-0.67	0.02	0.11	0.14	0.02	0.05
The year	11.33		9.92	10.32	12.34	9.75	8.74
Departure from normal		-6.74		-8.86	-4.00		

T = trace, less than .01 inch.

1941	—Portales—		Portales				
	Precip.	Dep't.	Evap. Station	Clovis	Elida	Floyd	Melrose
January	0.31	+0.07	0.25	0.35	0.63	0.29	0.37
February	0.09	-0.29	0.05	0.25	0.12	0.08	0.41
March	3.01	+2.34	3.11	2.48	3.18	3.67	3.18
April	1.60	+0.22	2.98	3.43	2.45	2.88	3.35
May	12.05	+9.97	16.87	11.58	15.41	9.96	.....
June	7.45	+4.76	6.11	8.57	2.62	3.60	3.87
July	3.62	+0.84	5.43	4.60	6.31	4.57	5.37
August	2.29	-0.45	4.42	2.02	2.88	0.97	.....
September	7.66	+5.38	9.47	6.79	9.17	7.15	.....
October	5.20	+3.87	5.19	5.96	4.00	5.97	6.44
November	0.33	-0.47	0.78	0.16	0.23	0.70	..
December	0.49	-0.21	0.59	0.43	0.25	0.48	0.51
The year	44.10		54.65	46.91	43.42	45.77	.....
Departure from normal		+26.03		+27.73	+27.08		

PRECIPITATION, IN INCHES, AT PORTALES, NEW MEXICO  
1931-1941

Year	Precipitation	Departure from normal	Precipitation during growing season April- September	Departure from normal April- September
1931	16.90	-1.17	13.38	-0.57
1932	19.70	+1.63	17.13	+3.18
1933	17.47	-0.60	14.80	+0.85
1934	17.08	-0.99	12.59	-1.36
1935	14.50	-3.57	12.38	-1.57
1936	18.58	+0.51	16.11	+2.16
1937	17.44	-0.63	14.01	+0.06
1938	16.97	-1.10	11.32	-2.63
1939	16.89	-1.18	11.96	-1.99
1940	11.33	-6.74	8.09	-5.86
1941	44.10	+26.03	34.67	+20.72

The total deficiency in rainfall for the years 1931-1940 was 13.84 inches at Portales, 22.36 inches at Clovis, and 18.68 inches at Elida. The record of water levels in the valley during this period has therefore covered a period of marked deficiency in rainfall. These deficiencies in rainfall were wiped out by the large rainfall which occurred during 1941. The accumulated departure from the normal for the period from 1931 to 1941 was +12.19 inches at Portales, +5.37 inches at Clovis and +8.40 inches at Elida.

The second table gives a summary for the years 1931-1941 of the precipitation at Portales, the departure from normal, and the precipitation and departure from normal during the growing season. As seen from this table the percentage of the yearly precipitation that falls during the growing season is not constant. The irrigation requirements of the crops in the valley vary considerably from year to year due to variation in the amount of rainfall during the growing season and also due to the variation in the intensity and frequency of the rains.

The following table shows the monthly evaporation at the Portales Evaporation Station, located in Sec. 12, T. 1 S., R. 33 E., from 1938 to 1941, inclusive, as reported by the United States Weather Bureau.

EVAPORATION, IN INCHES, AT THE PORTALES EVAPORATION  
STATION

Month	1933	1939	1940	1941	1934-1941 Average
January	3.04	3.88	1.42	2.39	a2.82
February	2.94	2.71	4.36	3.20	b3.50
March	6.82	9.36	8.48	5.83	a7.56
April	8.90	7.39	9.16	8.74	9.04
May	10.65	7.66	9.95	9.97	10.11
June	12.30	12.81	11.52	9.87	12.08
July	11.34	11.52	14.78	9.79	12.43
August	12.51	9.53	8.92	8.34	10.74
September	7.03	11.46	10.25	6.44	8.50
October	7.17	7.10	6.96	5.19	6.44
November	6.34	3.27	4.79	3.45	4.44
December	5.60	4.00	2.81	2.81	3.03
TOTAL	94.64	90.69	93.40	76.02	c90.69
Total April- September	62.73	60.37	64.58	53.15	62.91

a Does not include 1934.

b Does not include 1934 and 1936.

c Sum of monthly averages, not average of yearly totals.

### WATER PUMPED FROM WELLS

Ground water in Portales Valley is used for domestic, stock, and irrigation purposes and for municipal and industrial supplies. The largest use by far is for the irrigation of crops.

In a previous report, Theis<sup>4</sup> estimated the pumpage in Portales Valley, mainly for irrigation, as being 22,000 acre-feet in 1931; 17,000 acre-feet in 1932; 13,000 acre-feet in 1933; 18,000 acre-feet in 1934; 20,000 acre-feet in 1935; and about 22,000 acre-feet in 1936 and 1937.

According to Mr. Frank Craddock of the Portales Chamber of Commerce, a survey in 1935 indicated that about 10,000 acres of land in the valley was irrigated in that year. A rough survey by Mr. Conover indicated that approximately 11,000 acres was irrigated in 1938.

4. Theis, C. V., op. cit. (12th and 13th Bienn. Rept.), p. 107.

Estimates supplied by the Portales Chamber of Commerce and the office of the County Agricultural Extension Agent for the acreage of various crops under irrigation in the valley in 1939 are given below.

ACREAGE OF CROPS IRRIGATED IN PORTALES VALLEY, 1939

Crop	Acres
Sweet potatoes .....	1,300
Peanuts .....	2,700
Tomatoes .....	650
Green beans .....	400
Alfalfa .....	200
Onions and peppers .....	100
Miscellaneous truck .....	180
Sorghum grains and cotton .....	7,500
Total .....	13,030

Figures taken from the 1939 listing sheets of the Roosevelt County Agricultural Conservation Association give an irrigated acreage of approximately 12,900 acres. No special classification was made on these listing sheets for irrigated land except to give these lands a larger productivity index than given to dry farmed land. The average productivity index of the valley, including both irrigated and dry farmed lands, is approximately 100. Lands having a productivity index of 140 or more were taken as being irrigated. This office stated there was approximately 18,000 acres of cotton in the county, of which it was estimated about one-fifth was irrigated.

Estimates were obtained from about 20 irrigators during 1939 as to the amount of water pumped for different crops. The following table, prepared from these estimates, shows the mean number of waterings and the approximate water pumped for different crops in the valley.

MEAN WATER REQUIREMENT AND WATER PUMPED FOR  
VARIOUS CROPS IN PORTALES VALLEY, 1939

Crops watered	Number of waterings	Acre-feet per acre	Total acreage	Pumpage acre-feet
Sweet potatoes	8	2.4	1,300	3,120
Peanuts	3	1.0	2,700	2,700
Tomatoes	11	2.6	650	1,690
Green beans	10	2.4	400	960
Alfalfa	11	4.0	200	800
Cotton	3	1.0	3,600	3,600
Onions and peppers	11	3.2	100	320
Miscellaneous truck	-	2.5	180	450
Sorghum grains	3	1.0	3,900	3,900
Total			13,030	17,540

The number of estimates obtained for each crop was somewhat less than 20 as each irrigator did not supply information on all crops. The estimates for the same crop varied considerably among different irrigators, only those obtained for alfalfa showed much consistency. The above values may represent closely the water required for the crops, but it is thought that the amount actually pumped is somewhat greater due to wastage and other miscellaneous losses. Assuming the loss and uncounted waterings as being 10 per cent, the total pumpage for irrigation in 1939 was approximately 19,500 acre-feet. Using this basis for 11,000 acres irrigated in 1938, it is probable that about 16,500 acre-feet of water was pumped for irrigation in that year. This amount of water represents an average of 1.5 feet applied on the land.

In the following table is given a compilation of the pumpage in 1939 of 23 pumps in Portales Valley for which fuel records were available. Eleven of these pumps used metered natural gas for fuel and the others used gasoline and distillate. The rate of discharge and the rate of fuel used were measured for nine of the pumps using natural gas and were estimated for the other two. The rate of use of fuel for pumps using gasoline and distillate was obtained from the owners. The discharge rate of 7 of the gasoline and distillate pumps was measured, the rest are estimates made by Mr. Conover. The data on acreage of land irrigated by each pump and type of crop raised were obtained from the owners.

## AMOUNT OF GROUND-WATER PUMPED FOR IRRIGATION ON VARIOUS FARMS IN PORTALES VALLEY, 1939

NAME	Well location number	Type of fuel(1)	Rate of fuel use(2)	Discharge rate g.p.m.	Rating (3)	Total fuel (4)	Pump- age Acre-feet	Total land watered acres	Duty of water Acre-feet per acre	Type of crop
Loy, R. D.	1.33.14.111	G	2.9	600±	12,400	825	31.4	45	.70	Little truck, mainly sorghum grains
Jones, J. E.	1.33.24.433	G	2	640	19,190	1,200±	70.7	60	1.18	Cotton, tomatoes, corn, peanuts, sweet potatoes, sorghum grains
West, Drew	1.33.25.213	G	3.5	690	11,820	1,925	69.8	39	1.79	Mainly truck
Thomas, D. E.	1.33.26.221	D	2.0+	675	20,240	1,150	71.4	50	1.43	Alfalfa, sweet potatoes, sorghum grains
Ross, A. G.	1.34.20.312 1.34.20.331	G	3.5	780	13,360	5,250	215.3	130	1.66	Mainly truck crops
Minick, H. O.	1.34.21.232	G	2.75±	750	16,360	2,710	136.1	72	1.89	Sweet potatoes, cotton, sorghum grains, green beans, alfalfa, peanuts, corn, tomatoes, sudan
Mahaffey, J. R.	1.34.23.311	G	3±	650	13,000	810	32.3	35	.92	Sweet potatoes, grapes, cane, corn
Yandell, E. L.	1.34.23.422	G	3	800±	16,000	735	36.1	42	.86	Sweet potatoes, peanuts, sorghum grain
Gorrell, J. T.	1.34.24.243	G	3	650±	13,000	800	31.9	38	.84	Truck, corn, sorghum grains
Dick, J. C.	1.35.28.143	G	3+	768	15,360	1,125	53.0	12	4.42	Sweet potatoes
Davis, S. W.	2.36.8.412	G	2	900	27,000	1,500	124.2	53	2.34	Sweet potatoes, corn, cotton, pasture
Davis, W. O.	2.36.30.321	G	2+	1,000±	30,000	2,400	221.0	122	1.81	Onions, tomatoes, green beans, orchard, cotton, alfalfa, sorghum grains
Pitts, J. D.	1.34.25.222	NG	334	470	84,400	91.4	23.7	35	.68	Peanuts only

AMOUNT OF GROUND-WATER PUMPED FOR IRRIGATION ON VARIOUS FARMS IN PORTALES VALLEY, 1939  
(Continued)

NAME	Well location number	Type of fuel (1)	Rate of fuel use (2)	Discharge rate g.p.m.	Rating (3)	Total fuel (4)	Pump-age Acre-feet	Total land watered acres	Duty of water Acre-feet per acre	Type of crop
Pounds, J. C.	1.34.25.400	NG	300±	600±	120,000±	62.2	22.9	12	1.91	Some truck
Bollinger, J. H.	1.34.25.230	NG	300±	600±	120,000±	120	44.2	17½	2.52	Alfalfa, peanuts, potatoes, green beans
Bowman, Haskell	1.34.27.211	NG	317	678	128,200	133.0	52.4	37	1.42	Potatoes, tomatoes, peanuts, alfalfa, sorghum grains
Bollinger, R. H.	1.34.27.231	NG	390	603	92,800	79.1	22.5	20±	1.12	Sweet potatoes, peanuts
Outhouse, E. W.	1.34.27.241	NG	298	762	153,400	109.0	51.4	20(-)	2.57	Mainly alfalfa
Bennett, B.	1.34.34.133	NG	276	595	129,400	42.4	16.8	24±	.70	
Sanders, J. A.	1.34.34.143	NG	299	523	105,000	71.8	23.1	39	.59	Mainly orchard and vineyard, little truck
Beebe, H.	1.34.34.221	NG	345	725	126,000	188.3	72.8	18	4.04	Alfalfa only
Orr, Fred L.	1.34.34.233	NG	315	625	119,000	116.4	42.5	19	2.24	Mainly truck, some sorghum grains
Bennett, B.	1.34.34.311	NG	298	563	113,500	48.9	17.0	543	.40	
Total							1465.5	940	1.56	

Natural gas records, courtesy New Mexico Eastern Gas Company, Portales.

1. G = gasoline, NG = natural gas, D = distillate.
2. Gasoline and distillate, gallons per hour; natural gas, cubic feet per hour.
3. Gallons of water pumped per gallon of gasoline or distillate, or per 1,000 cubic feet of natural gas.
4. Gallons of gasoline and distillate, 1,000 cubic feet natural gas.
5. Probably not all watered; not included in totals.

As seen from the table, the water consumption varied from a minimum of 0.59 foot to a maximum of 4.42 feet. The main reason for this variance is due to the type of crop raised and to the type of farming. On some farms irrigation of crops is practiced only to supplement the rainfall while on others the crops are irrigated intensively. The tract of Mr. H. Beebe is devoted exclusively to alfalfa. The water consumption of 4.00 feet on this tract agrees with the figure obtained for the consumption of alfalfa in the preceding table. The average water consumption determined for all these tracts was 1.56 feet, which agrees closely with that determined from data on the estimated amount of water pumped for each crop. Even though this average water consumption agrees closely in both cases, it is not certain that the type and amount of crops raised on these 23 farms are the average for the valley, but it does confirm to a certain extent the previous figure.

During 1940 and 1941, 57 electric pumps were installed in the Portales Valley under the supervision of the Rural Electrification Administration. The discharge and power consumption of these pumps were rated by the Rural Electrification Administration after installation. Estimates of the pumpage for 1940 and 1941 are based in part upon these ratings, using individual power consumption as furnished by the Rural Electrification Administration and individual irrigated acreages as determined by rough surveys made during the growing season.

The individual water use during 1940, as estimated from data for 22 pumps, varied from a minimum of 0.43 acre-foot per acre to a maximum of 4.52 acre-feet per acre with an average of 1.88 acre-feet per acre for 1425 acres. A rough survey during the summer of 1940 indicated that about 13,700 acres were under irrigation in 1940. Multiplying this figure by the average water use of 1.88 acre-feet per acre, the total pumpage for irrigation during 1940 was about 25,800 acre-feet.

The estimate for the pumpage during 1941 is based upon data for 28 of the electric pumps. The individual water-use during 1941 varied from 0.10 to 1.29 acre-feet per acre, with an average of about 0.65 acre-foot per acre for 1620 acres. This small water use was due to the exceptionally large rainfall during the growing season. It is estimated that about 15,000 acres were under irrigation in 1941, giving a total pumpage for irrigation of about 9,750 acre-feet for the year.

The following table shows the pump ratings upon which the foregoing estimates were based.

PUMP RATINGS FOR ELECTRIC PUMPS IN PORTALES VALLEY  
(From records of the Rural Electrification Administration)

Well location number	Total lift (feet)	Acre-feet of water pumped per 1000 KWH	Date rated
1.33.10.431	35.6	16.7	June 30, 1941
1.33.12.144	58.7	10.5	..... 1940
1.33.14.311	32.0	13.7	June 20, 1941
1.33.15.114	37.3	14.9	..... 1940
1.33.15.212	47.6	12.8	..... 1940
1.33.15.431	32.0	14.0	July 7, 1941
1.33.16.431	39.0	13.6	..... 1941
1.33.25.331	68.4	10.8	..... 1940
1.33.26.442	.....	9.4	..... 1940
1.33.27.321	50.0	13.0	June 14, 1941
1.33.27.411	50.0	11.7	..... 1940
1.33.36.112	68.3	10.3	..... 1940
1.34.16.332	62.0	11.0	..... 1940
1.34.17.131	47.0	11.5	June 12, 1941
1.34.18.131	53.8	11.7	June 30, 1941
1.34.18.332	59	9.9	..... 1940
1.34.19.121	45.5	11.7	Dec. 9, 1940
1.34.19.211	40.7	12.7	..... 1940
1.34.19.341	55	8.6	Sept. 1940
1.34.20.331	48	14.8	..... 1940
1.34.21.241	52.5	11.7	..... 1940
1.34.27.321	36.0	15.1	June 11, 1941
1.34.30.221	.....	11.0	..... 1940
1.35.29.331	58	11.5	..... 1940
1.35.30.113	35.8	11.6	June 19, 1941
1.35.32.311	36.8	14.7	July 2, 1941
1.35.33.331	45	14.0	May 27, 1941
2.34.1.331	.....	13.5	..... 1940
2.34.1.431	39.3	13.9	June 19, 1941
2.34.11.122	49.3	13.0	June 4, 1940
2.34.5.213	41.5	13.2	..... 1940
2.36.19.113	35.8	14.7	June 13, 1941
2.36.21.432	35.8	14.3	June 14, 1941
2.36.26.423	50	9.2	Sept. 5, 1940
2.36.34.222	24.5	20.8	Dec. 10, 1940

The figures for average water-use for irrigation as reported herein vary from 1.50 to 1.88 acre-feet per acre, exclusive of the very wet year of 1941, as compared with a figure of 2.5 acre-feet per acre reported by Theis<sup>5</sup>. As stated by Theis, during the early part of the investigation, the crops grown in the valley were largely truck crops and alfalfa, requiring large amounts of water, whereas in the later years much acreage was planted to crops of low water-requirement—cotton, peanuts,

5. Theis, C. V., op. cit., (12th and 13th Bienn. Rept.), p. 108-109.

and sorghum grain. Large acreages of the low water-requirement crops are grown in the valley by dry farming methods alone. This tendency to grow crops of low water-requirement has reduced the average water-use by irrigation in the valley, but, because of the increased acreage, the total pumpage has not been reduced.

Estimates by officials of the city water department at Portales indicated that for 1938, 1939 and 1940, the water consumption of the City of Portales was about 300 acre-feet per year. It is thought that the consumption during 1941 was only about 50 or 60 per cent of the consumption during previous years.

### CHANGES IN WATER LEVEL

Maps and tables showing the changes in the water level in Portales Valley from 1932 to 1938 have been published in previous reports<sup>6</sup>.

Data showing changes in the water level from 1939 to 1941, inclusive, are published or are to be published in U. S. Geological Survey Water-Supply Papers 886, 911, and 941.

Figure 1 shows the change in water level in the Portales Valley from February 1938 to January 1940, and figure 2 shows the change in water level from January 1939 to January 1940. In the heavily pumped area extending west and northwest from Portales, the water level declined significantly during the two year period. The greatest observed decline in the area was 4.23 feet in well 1.34.21.121. The water level rose in a large area southeast of Portales, extending from a heavily pumped area just east and southeast of Portales, through lightly pumped areas farther east, to the vicinity of Arch. Water levels also rose in an area northwest of Portales at the western edge of the heavily pumped area.

The rise of the ground-water level in the outlying districts suggests that there was a tendency for the water level to rise over the whole area, with the effects of the rise being obscured by pumping effects in the area of decline. The rise was probably due to a combination of causes largely involving generally reduced pumpage in 1938 and locally reduced pumpage in 1939.

Figure 2 shows the continued lowering of water level in the heavily pumped area northwest of Portales from January 1939 to January 1940. In this area the water level declined more than one foot over an area of approximately 17 square miles. The maximum observed decline of ground-water level in this period amounted to 1.80 feet and occurred in wells 1.34.18.343 and 1.34.21.141 about 5 and 3 miles, respectively, northwest of Portales.

In another area of heavy pumping, east of Portales, the ground-water level rose more than one-half foot between January 1939 and January 1940 over an area of approximately 7 square miles. The maxi-

6. Theis, C. V., op. cit. (11th Bienn. Rept.), pp. 101-107.

Theis, C. V., op. cit. (12th and 13th Bienn. Rept.), pp. 108-117.

Meinzer, O. E., Wenzel, L. K., and others. Water levels and artesian pressure in observation wells in the United States in 1938, U. S. Geol. Survey, Water-Supply Paper 845, pp. 249-278, 1939.

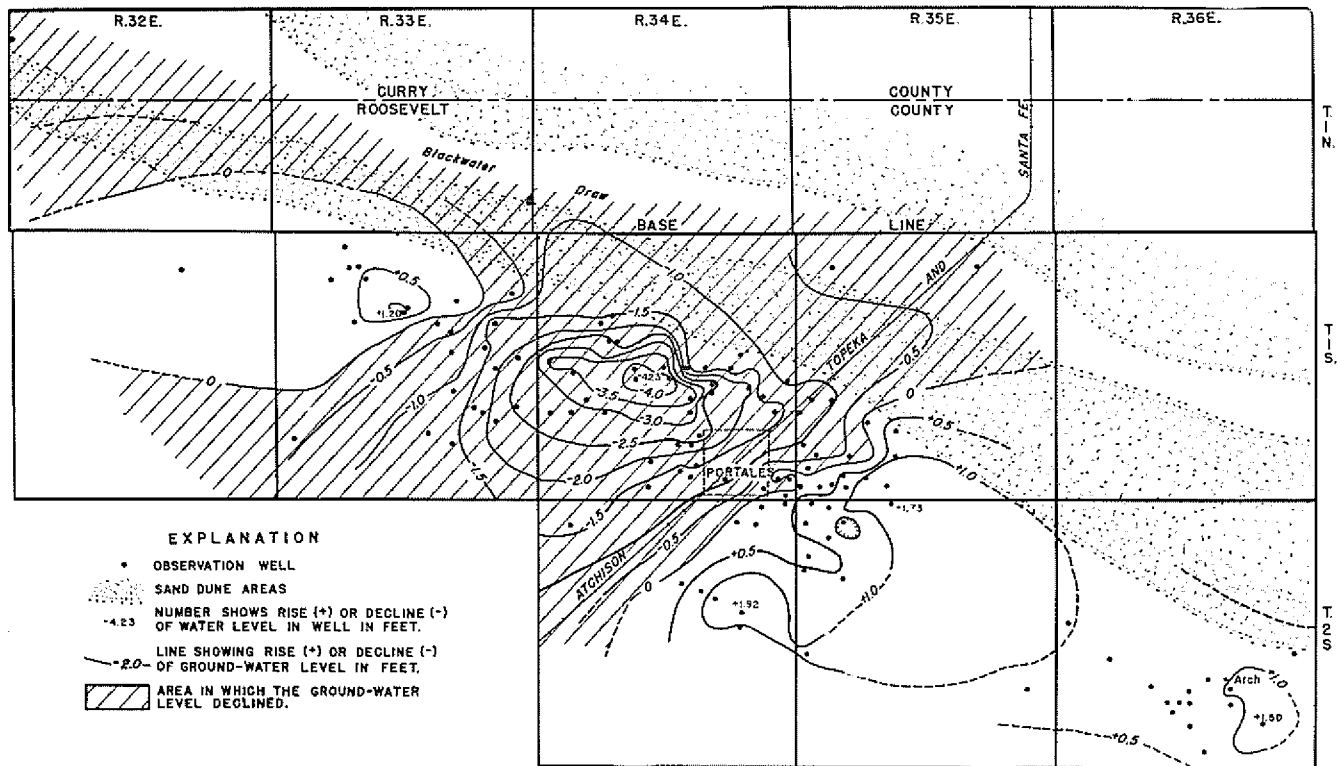


FIG. 1. Map of Portales Valley, N. M., showing change in ground water levels from February 1938 to January 1940.

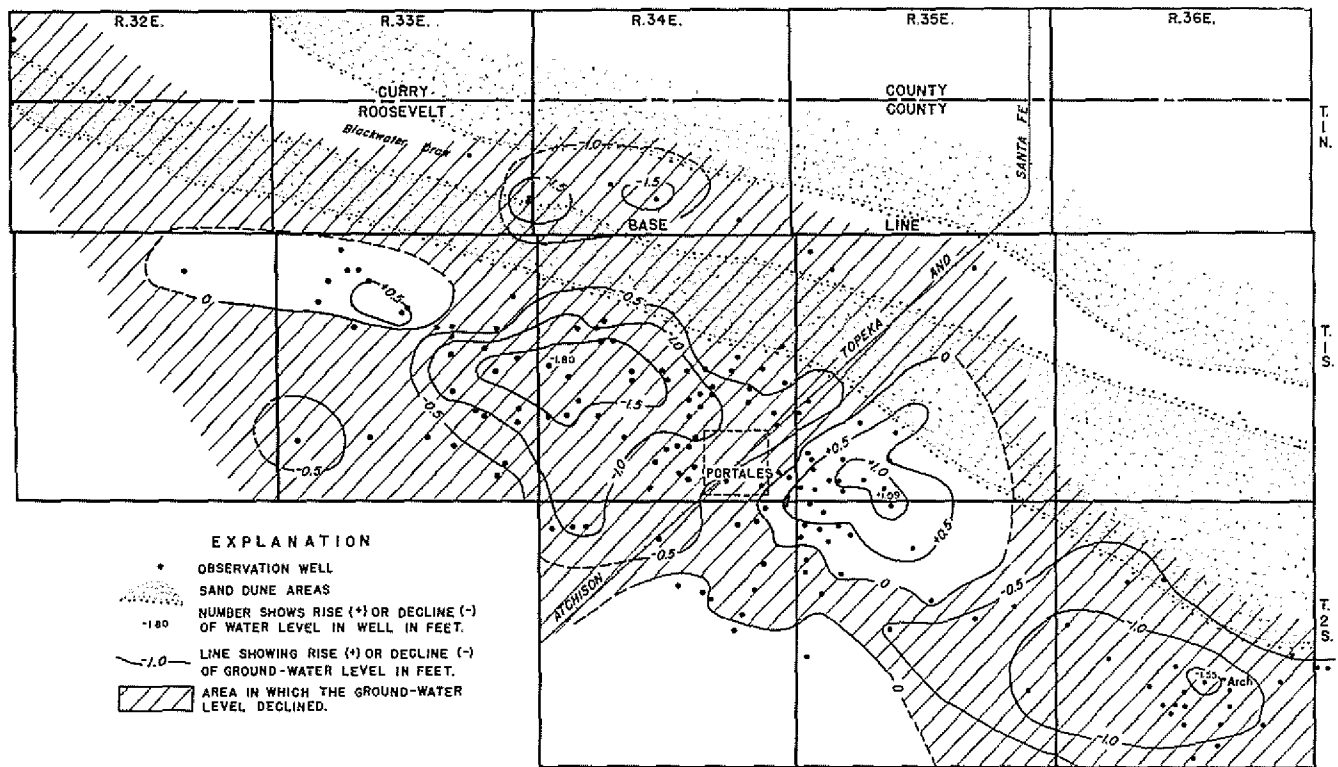


FIG. 2. Map of Portales Valley, N. M., showing change in ground water levels from January 1939 to January 1940.

imum observed rise was 1.09 feet and occurred in well 1.35.33.331, approximately 3 miles southeast of Portales. Local severe hail storms during the growing season damaged many of the crops in this area to the extent that the crops were abandoned and the land was not watered in the latter part of the season. Frequent rains also came when the crops needed water, thus reducing the amount of water pumped. The decrease in pumping due to the hailstorms and rains is probably the principal cause for the net rise of ground-water level in this area during 1939.

The ground-water level declined in the neighborhood of Arch from January 1939 to January 1940. The maximum observed decline, amounting to 1.55 feet, occurred in well 2.36.27.211, one-half mile west of Arch. This decline followed a rise in this area during the two previous years.

The Arch area is underlain by ground water only from 8 to 15 feet below the land surface. Little Salt Lake and Big Salt Lake are ground-water lakes that lie about 3 miles southwest and 3½ miles southeast, respectively, from Arch. These lakes are points of ground-water discharge. At times of heavy precipitation, considerable surface run-off, principally from the southwest, discharges into these lakes causing higher lake levels and probably reducing the ground-water discharge. North of Arch there is a considerable area of sand dunes which constitute a favorable catchment area for precipitation.

Figure 3 shows the change in ground-water level in Portales Valley between January 1940 and January 1941. The precipitation at Portales during 1940 was only 11.33 inches, 6.74 inches below normal. The estimated pumpage was greater for this year than for any other year since ground-water studies were begun in the valley in 1931. The ground-water level declined throughout the valley with a maximum decline occurring in the two heavily pumped areas northwest and east of Portales. The water levels declined more than 1 foot over an area of about 86 square miles and more than 2 feet over an area of about 24 square miles. The maximum observed decline was 6.24 feet in well 1.34.18.343, about 5 miles northwest of Portales.

Figure 4 shows the change in water levels in Portales Valley from January 1941 to January 1942. Ground-water levels in the valley rose to unexpected high levels during 1941 as a result of the unprecedented large rainfall during the year, giving rise to exceptionally great recharge as well as causing a great decrease in pumpage. Water levels rose in all observation wells during the year. The greatest observed rise was 14.75 feet in well 1.34.27.341. Water levels rose more than 8 feet in an area of more than 100 square miles lying along the axis of the valley to the south and west of Portales and in Blackwater Draw north of Portales. Water levels also rose more than 8 feet in a small area of about 6 square miles near Arch.

Figure 5 shows the change in water level in Portales Valley during the 9-year period from January 1932 to January 1941. The map is based on measurements in 24 wells distributed throughout the valley which were observed continuously during the period. The cone of de-

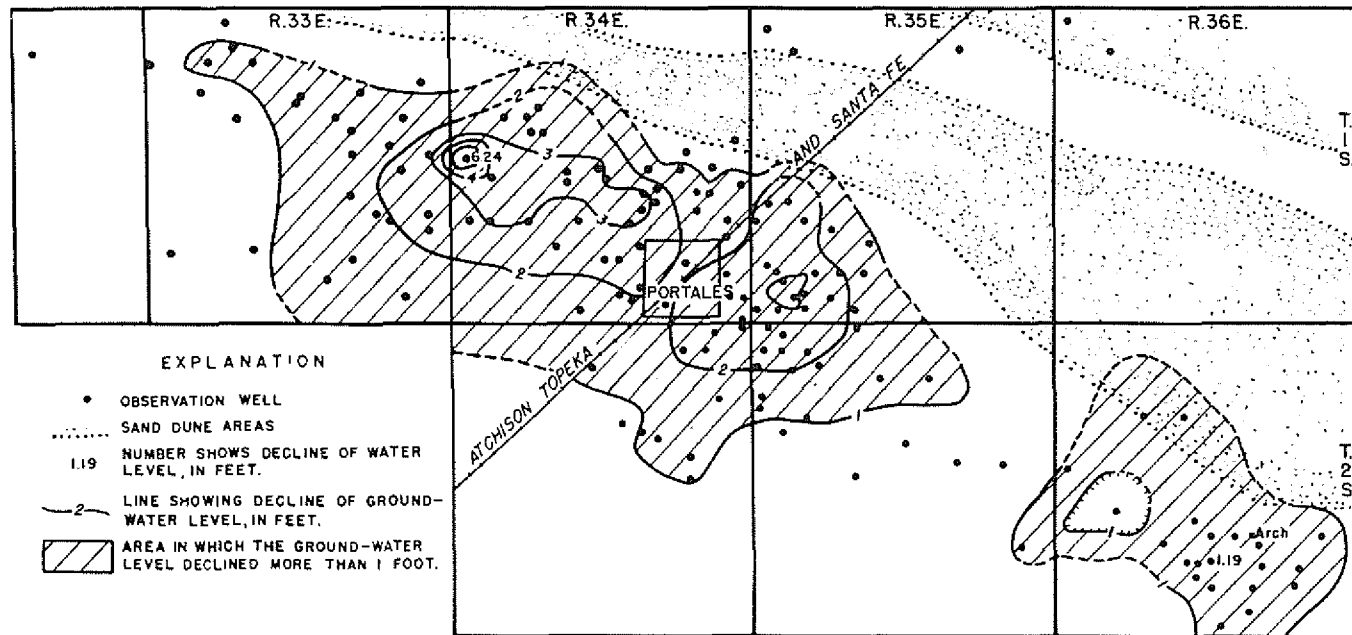


FIG. 3. Map of the Portales Valley, N. Mex., showing change in ground-water level from Jan. 1940 to Jan. 1941.

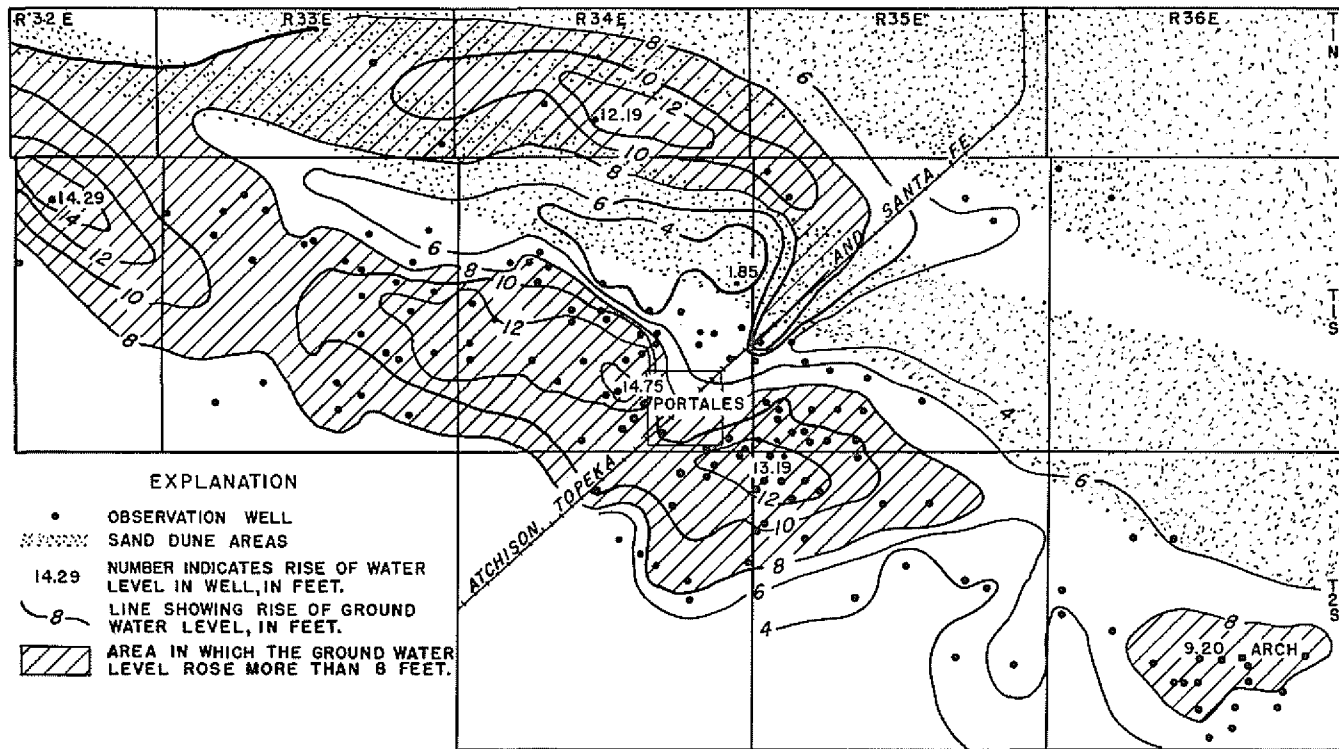


Fig. 4. Map of Portales Valley, N. M., showing change in ground water levels from Jan. 1941 to Jan. 1942.

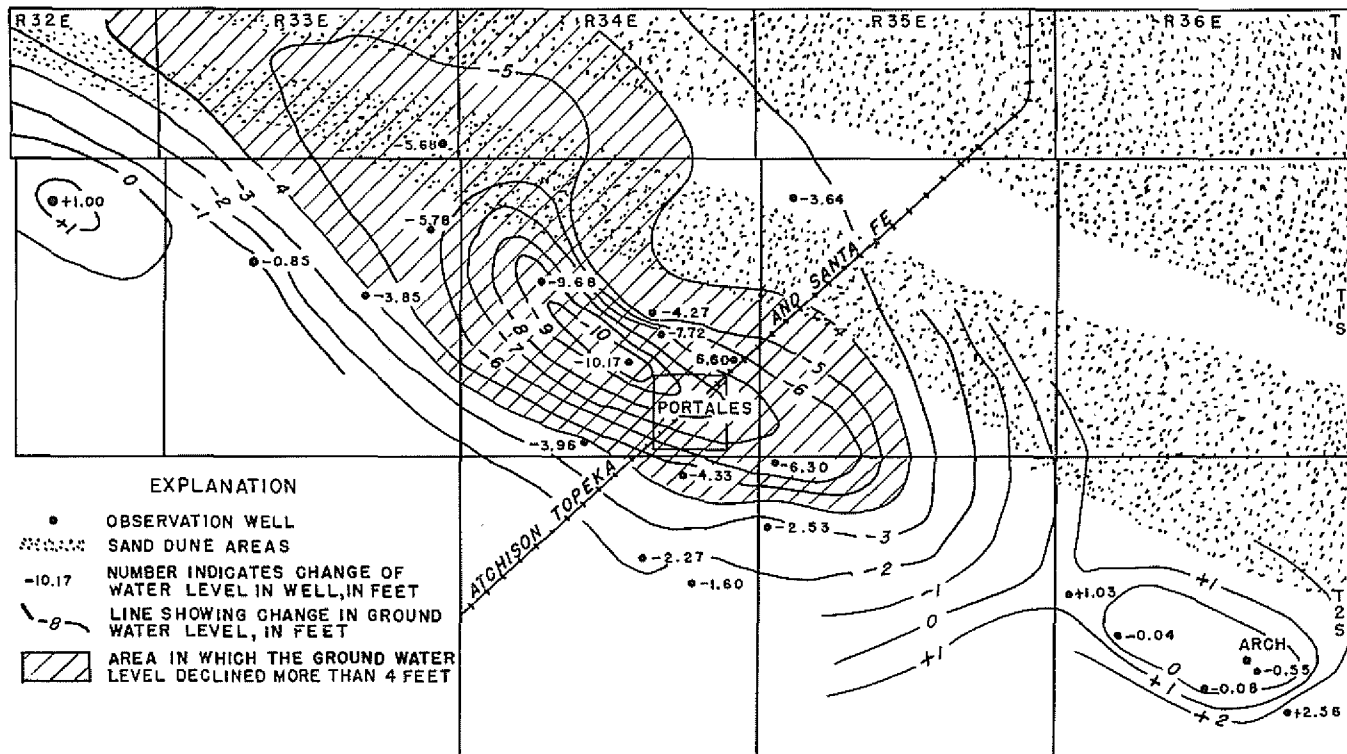


Fig. 5. Map of Portales Valley, N. M., showing change in water levels from Jan. 1932 to Jan. 1941.

pression created by pumping in the heavily pumped areas near Portales is clearly illustrated. Water levels declined over most of the area, the greatest observed decline being 10.17 feet in well 1.34.27.211. Small net rises occurred in the western part of the valley at the edge of the pumping districts and in the outlying areas near Arch. In the heavier pumped areas near Arch, however, there was a small decline amounting to 0.55 foot in well 2.36.26.131. As stated previously, the water levels in these areas showed tendencies to rise for some years prior to 1940.

Figure 6 shows the change in water level in the Portales Valley during the ten year period from January 1932 to 1942. This map is based on measurements in 25 wells. During this period there was a net rise over most of the area. The greatest observed rise was 15.29 feet in well 1.32.3.440 at the western edge of the pumping district. A rise of 9.15 feet was observed in well 2.36.35.212 near Arch. The unusual rise of the water level in 1941 did not completely wipe out the cone of depression caused by pumping in the previous years, however, water levels declined during the 10 year period in a narrow area north and northwest of Portales in the heavily pumped area. The greatest observed decline was 2.10 feet in well 1.34.25.211.

A study of figures 4, 5, and 6 indicates that the larger rise in the ground-water level did not occur primarily in the areas where the water level had declined the most in previous years, although this was the case in some localities. The peak of the rise in the Portales Valley proper followed generally along the axis of the valley and, north of Portales, the rise seemed to center along Blackwater Draw. Decreased pumping allowed recovery of the water levels to some extent, probably over the entire area, but this effect was probably minor except in the areas northwest and north of Portales, where the previous cone of depression was the deepest. The major part of the rise was due to actual recharge to the ground-water body. Numerous small depressions along the axis of the valley collected run-off during the heavy rains and formed concentrated sources for downward percolation. The frequency of the rains kept the ground comparatively wet for long periods, so that a large amount of the soil moisture could escape transpiration and evaporation and could percolate down to the water table. The evaporation in the area was considerably less in 1941 than in previous years. The stages of the perennial lakes were increased by runoff, thereby decreasing the gradient of the water table in these areas and lessening the ground-water discharge at these points.

The nature and distribution of the ground-water rise suggests that major recharge may occur by downward percolation at almost any point in the area, and that the most significant recharge area may be along the axes of Portales Valley and Blackwater Draw rather than in the sand dune areas between the two valleys as was formerly supposed. There are too few wells in the sand hill area and Blackwater Draw to accurately place the crest of the water table to the north of Portales Valley, but there is a suggestion in the shape of the water table to the north<sup>7</sup>, considered with the localities of greatest rise of the water table

7. Theis, C. V., op. cit. (10th Bienn. Rept.), p. 128.

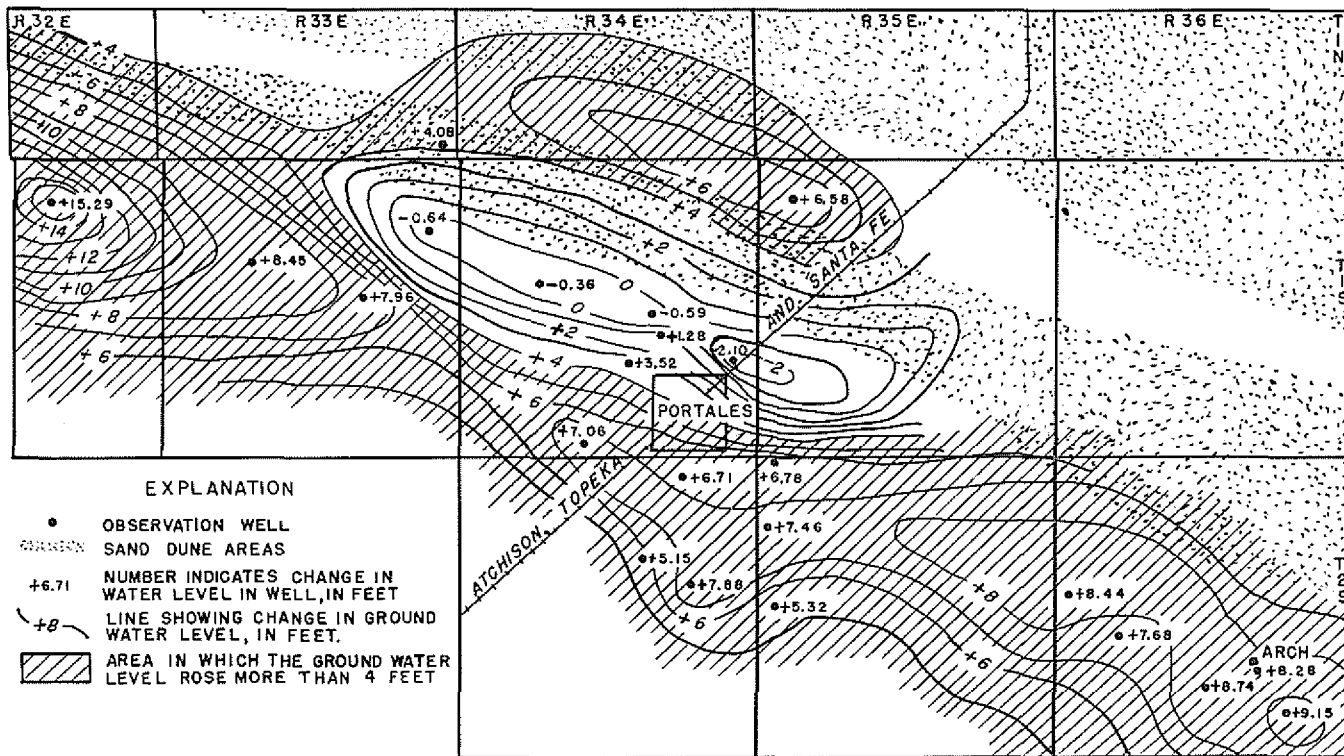


FIG. 6. Map of Portales Valley, N. M., showing change in ground water levels from Jan. 1932 to Jan. 1942.

in 1941, that the sand hill area may furnish more recharge during normal seasons but that the valleys furnish more during exceptional rainfalls, when opportunity is afforded for the formation of temporary pools of water in the low areas.

Figure 7 shows hydrographs for two wells in the vicinity of Arch from 1932 to 1939 and the weekly precipitation at Portales as reported by the United States Weather Bureau. Well 2.36.28.114b was not used during this period. Well 2.36.27.311 is used for irrigation during the summer. This figure shows two major generalities, first a lowering of water level during summer months and a rise during winter months, and secondly a rise after periods of exceptionally heavy precipitation.

The decline in water level during the summer months is attributed to effects of pumping for irrigation, to transpiration draft by vegetation, and to evaporation from the Little and Big Salt Lakes, which lowers the point of ground-water discharge.

The hydrograph shows two periods when the water level rose a large amount. In the last week of August 1933 a total of more than 8.6 inches of rain fell with a consequent rise of from 1.5 to 2 feet in water level. In 1938 from the last two weeks in July through the first two weeks in October a total of more than 9.8 inches of rain fell. This occurred principally in 3 periods of heavy precipitation and produced by early 1939 a rise in water level of about 2 feet. In 1932 and also 1937 heavy showers in the latter part of the year produced small net rises in the water level over the preceding year. In the latter part of May 1936, more than 3.5 inches of rain fell with only a small temporary rise of water level, and in the last week of May 1937 about 5.25 inches of rain fell with no net rise in water level. Heavy rainfall occurs mainly in the summer months and is less effective in raising the ground-water level in the Arch area than comparable amounts in the fall and winter.

Figure 8 shows the water-level fluctuations in three wells in the Portales Valley from 1932 to 1939. The water level in well 1.34.23.313a, which was not used during the period and which is located near the center of heavy pumping just northwest of Portales, shows the characteristic fluctuations due to pumping, that is, a lowering during the summer months and a rise during the winter. This graph shows the gradual decline in water level that has occurred in the heavily pumped area. The high water level in 1933 was probably due in part to the reduced amount of pumping as a result of the economic depression<sup>8</sup> and in part as a result of the above-normal precipitation during the growing season of 1932.

The hydrograph for well 1.35.6.400, which was not used during the period, shows a gradual decline of water level except in 1933. This well is located in Blackwater Draw about four miles northeast of Portales, and about 3 miles from any heavily pumped wells. This decline in water level may have been partly caused by pumping as evidenced by the rise in water level in 1933 coincident with the rise shown in the previous graph, although this large rise in 1933 was probably due mainly to the above-normal precipitation in 1932. The gradual decline was

8. Theis, C. V., *op. cit.*, (12th and 13th Bienn. Rept.), pp. 107 and 114.

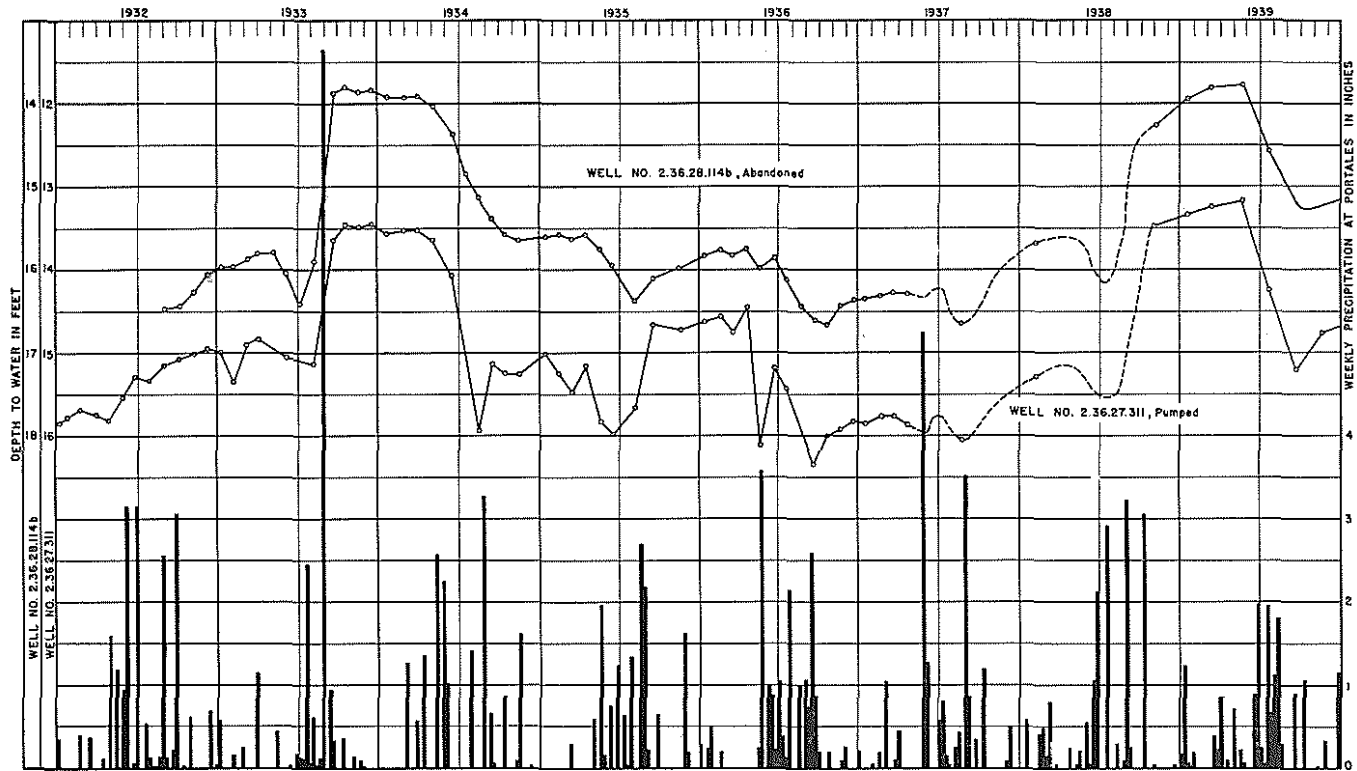


FIG. 7. Hydrograph of an abandoned and a pumped well at Arch, N. M., and weekly precipitation at Portales, N. M.

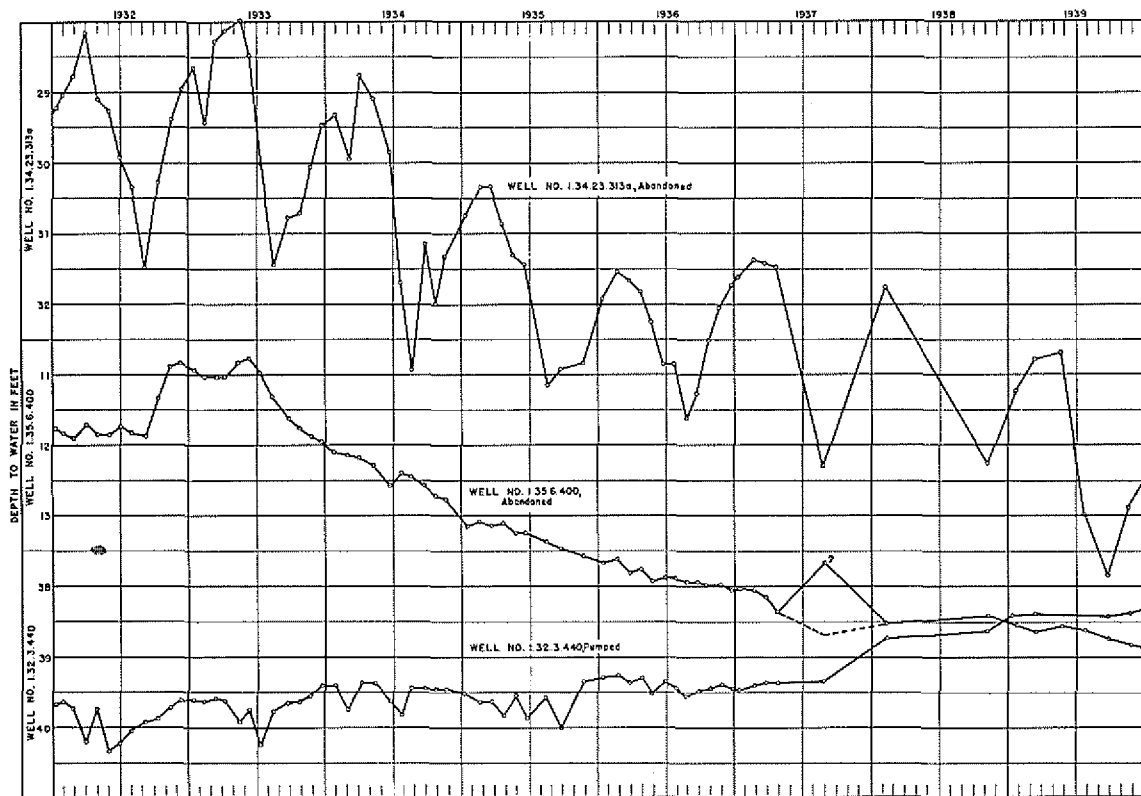


FIG. 8. Hydrographs of three wells in Portales Valley, N. M., 1932-1939.

probably caused in part by the subnormal rainfall during most of the period and in part by the pumping in Portales Valley.

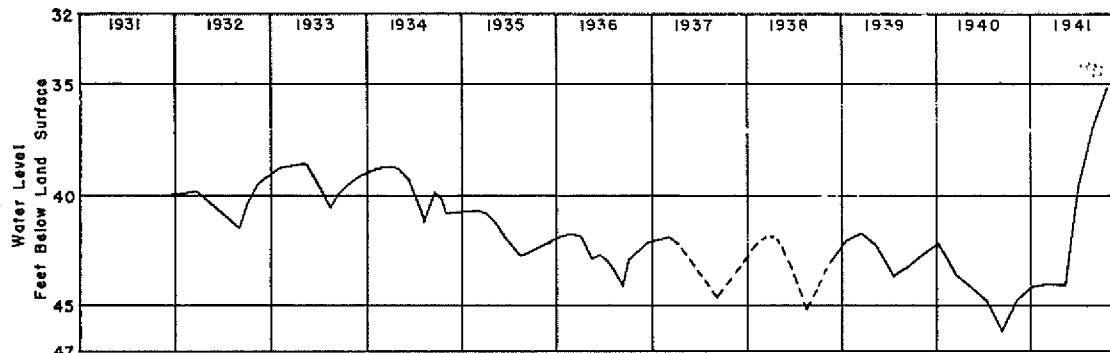
Well 1.32.3.440 is a lightly pumped well located on the western edge of the irrigated area, about 13 miles northwest of Portales. The hydrograph of the well shows the gradual rise in water level that has occurred during the period shown. As stated on a previous page, this rise in water level suggests that perhaps there has been a tendency toward a rise of ground-water level throughout the valley, although such a tendency in the irrigated districts has been offset by pumping.

Figure 9 shows a hydrograph of well 2.34.2.233, an unused well equipped with an automatic water-stage recorder, from November 1931 to December 1941 and the monthly rainfall at Portales during the period. The well is located about one-half mile south of Portales. The hydrograph shows the fluctuations characteristic of many of the wells in the valley, the lowering in the summer caused by pumping, the recovery in the winter, and small rises after periods of rainfall. The increased lowering caused by the lack of rainfall and heavy pumping during 1940 and the sharp rise in 1941 beginning after the first heavy rains in May are shown. The water-level rise continued during the rest of the year, and in January 1942 the water level in this well was 6.71 feet higher than in January 1932.

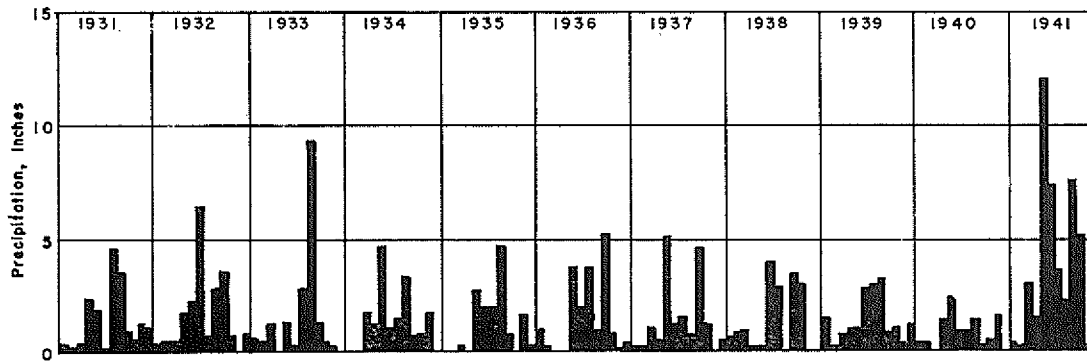
The following tables give the yearly measurements of depth to water in observation wells from February 1938 to January 1942. The water-level readings are referred to the depth below land-surface datum, a datum that corresponds to the actual land surface as closely as it can be determined but which is referred to one or more permanent points in the vicinity in order to make it definite.

The well location number serves the dual purpose of locating and designating a well. The number is divided into segments by periods. The first segment gives the number of the township, the second gives the range, and the third gives the section. The section is divided into quarters, numbered respectively 1, 2, 3, and 4 for the NW, NE, SW and SE quarters, and each quarter is divided into 40-acre tracts on the same basis. Likewise, the 40-acre tracts are divided into 10-acre tracts. The first, second, and third digits of the last segment denote respectively the quarter of the section, the 40-acre tract within the quarter, and the 10-acre tract within the 40-acre tract. Thus a well located in NE $\frac{1}{4}$  NW $\frac{1}{4}$  SE $\frac{1}{4}$  sec. 29, T. 14 S., R. 26 E. is designated as 14.26.29.412. If for some reason a well could not be located accurately to the 10-acre tract or 40-acre tract, a zero replaces the respective digits of the last segment of the well number. For instance, the well referred to above is designated as 14.26.29.400 if the location is accurate only to the quarter section. If two or more wells are in the same 10-acre tract, a letter a, b, c, or d is added to the number to designate individual wells. For townships north of the base line, an N is added after the township digit. The range is east of the New Mexico Principal Meridian in the Portales area.

In former reports, if a well could not be located within a specific 40-acre or 10-acre tract, places in the number representing these units



Hydrograph of Well 2.34.2.233 from November 1931 to November 1941.  
(Plotted from Monthly Water-Level Measurements)



Monthly Precipitation at Portales, New Mexico, from January 1931 to December 1941.

FIG. 9. Hydrograph of well 2.34.2.233 from Nov. 1931 to Nov. 1941, and monthly precipitation at Portales, N. M.

were simply omitted. Thus a well now designated as 14.26.29.400 would have been shown in former reports as 14.26.29.4. This rule should be followed in comparing records given herein with those in former reports: "If the number of the well ends in 0 herein, the same well was designated in former reports by the same number exclusive of the final 0 or 0's."

DEPTH TO WATER, IN FEET BELOW LAND SURFACE DATUM  
 1938-1942

Well location number	Feb. 1938	Jan. 1939	Jan. 1940	Jan. 1941	Jan. 1942
1N.32.7.300	17.08	17.67	a18.17	a18.78	15.27
1N.33.16.100a				26.14	19.24
1N.33.16.100b				25.57	18.71
1N.33.26.120		12.06	11.09	12.01	3.54
1N.33.36.400a	6.43	5.50	7.30	8.20	k 1.56
1N.33.36.400b		9.02	10.71	13.97	1.98
1N.34.29.444		a18.77	a19.88	20.62	10.78
1N.34.33.224		20.63	22.38	23.15	10.96
1N.34.35.432		21.54	21.85	22.56	a26.42
1.32.3.440	38.73	38.42	38.28	38.64	24.35
1.32.15.111			48.40	48.42	42.15
1.33.5.231	24.66	24.24	24.15	25.02	(e)
1.33.5.432	21.87	22.04	21.79	22.83	13.79
1.33.5.442	23.10	22.96	22.68		
1.33.7.111				22.02	12.17
1.33.8.112	21.15	21.22	20.83	21.93	12.57
1.33.8.311		22.41	22.15	23.00	13.33
1.33.8.411	20.60	20.22	(b)		
1.33.9.111		22.11	c21.69	22.86	14.28
1.33.9.442	21.96	21.81	20.76	21.95	13.94
1.33.10.211					20.15
1.33.10.313	23.52	23.36	22.86	24.03	15.69
1.33.11.312	25.03	(d)	24.69	25.87	19.17
1.33.12.144	33.28	33.38	33.70	34.42	29.28
1.33.13.111	22.50	24.02	24.29	25.70	18.79
1.33.13.431	24.72	25.39	26.96	29.88	19.23
1.33.14.111		21.84	22.04		
1.33.14.131	21.70	21.32	22.16	23.69	13.89
1.33.14.311	20.87	20.14	(d)		11.81
1.33.14.331	21.59	21.12	22.27	23.87	12.06
1.33.14.331b					12.01
1.33.14.421	23.54	23.64	24.88	26.57	15.33
1.33.15.212	21.52	c21.54	21.80	23.20	13.44
1.33.16.222					11.45
1.33.17.221	20.73	19.91	20.29	21.16	11.82
1.33.23.111				24.06	
1.33.23.311	23.73	c23.58	24.78	26.15	15.50
1.33.23.433	23.55	24.21	25.17	27.09	15.73
1.33.24.111	28.08	28.32	30.04	32.28	18.40
1.33.24.433	24.11	25.19	26.64	28.82	15.82
1.33.25.213	33.73	34.97	36.16	38.31	(e)
1.33.26.221	23.30	24.24	25.16	27.14	15.54
1.33.26.331	29.24	30.19	30.64	32.27	23.58
1.33.27.311				45.18	
1.33.27.411				36.44	27.79

DEPTH TO WATER, IN FEET BELOW LAND SURFACE DATUM  
1938-1942  
(Continued)

Well location number	Feb. 1938	Jan. 1939	Jan. 1940	Jan. 1941	Jan. 1942
1.33.27.421					23.75
1.33.28.311		46.19	46.41	47.30	40.22
1.33.29.333				37.03	30.19
1.33.30.	1.60	0.82	1.87	1.89	
1.33.34.211				28.94	19.77
1.33.36.112		31.93	32.50	(e)	
1.33.36.113		39.27	39.58	41.16	33.72
1.34.8.434	32.57	33.26	34.04	36.64	28.73
1.34.13.412		55.91	56.30	56.54	54.69
1.34.14.432	45.72	46.62	46.82	47.54	
1.34.16.422				47.96	44.12
1.34.17.111		32.81	34.09	36.27	29.61
1.34.17.122	31.89	32.68	33.67	36.34	28.15
1.34.17.233	29.62	30.68	32.44	35.20	25.88
1.34.17.241	26.67	27.50	29.04	31.81	23.17
1.34.18.133					25.64
1.34.18.312	28.59	29.97	(d)		
1.34.18.343	25.72	27.48	29.28	35.52	21.19
1.34.19.223	24.35	25.95	27.57	31.06	19.03
1.34.19.341				29.44	16.62
1.34.19.421	23.74	(d)	(d)		
1.34.20.331	26.38	27.84	29.50	(e)	
1.34.20.441	24.95	27.11	(e)		
1.34.21.121	30.71	33.25	34.98	38.08	26.36
1.34.21.141	30.67	33.10	34.90	37.94	25.82
1.34.21.211	32.76	(d,e)			
1.34.21.222	37.32	39.48	40.95	44.13	34.15
1.34.22.131	32.15	34.78	36.27	39.25	27.47
1.34.22.211	37.19	37.67	38.81	(e)	
1.34.22.222	40.90	41.86	42.35	43.52	39.84
1.34.22.413	31.07	33.23	34.66	(e)	
1.34.22.421		34.98	36.22	39.25	28.89
1.34.22.443	31.05	c32.42	33.56	36.76	23.65
1.34.23.112	39.14	(d)	(d)		
1.34.23.211	39.65	40.61	40.88	41.99	36.89
1.34.23.311	31.96	33.84	34.80	37.04	29.34
1.34.23.313a	31.77	33.21	34.25	26.74	27.75
1.34.23.341	30.56	(b)			
1.34.23.422	30.77	32.24	32.95	34.05	29.29
1.34.23.442	33.03	33.11	33.91		
1.34.23.442a				35.12	29.80
1.34.24.112		39.00	39.40	40.30	
1.34.24.243	46.00	46.72	46.94	48.14	42.65
1.34.24.312	32.25	33.21	33.64	34.81	29.51

DEPTH TO WATER, IN FEET BELOW LAND SURFACE DATUM  
1938-1942  
(Continued)

Well location number	Feb. 1938	Jan. 1939	Jan. 1940	Jan. 1941	Jan. 1942
1.34.25.200		34.86	35.66	36.89	29.20
1.34.25.211	36.20	37.10	37.83	39.14	34.64
1.34.26.122	33.30	(e)			
1.34.26.212	34.76	(e)			
1.34.26.312	29.62	(e)			
1.34.26.313	29.29	(e)			
1.34.26.342	31.84	(e)			
1.34.26.400				34.26	25.55
1.34.27.211	28.42	30.28	31.54	34.64	20.95
1.34.27.313	28.23	(d,e)			
1.34.27.331		28.48	29.39	31.72	18.90
1.34.27.341	27.05	28.58	29.52	32.09	17.34
1.34.27.412	27.92	29.63	30.69	33.42	20.17
1.34.27.431	27.57	29.11	29.82		
1.34.27.444				31.44	17.95
1.34.28.111					18.84
1.34.28.211				33.25	19.74
1.34.28.311		29.94	30.99	(e)	
1.34.28.311a				33.23	20.49
1.34.29.211	24.78	26.41	27.75	30.75	17.98
1.34.30.121	24.18	25.30	26.79	29.17	16.54
1.34.30.221	23.19	24.45	26.05	20.07	(e)
1.34.33.223	25.63	26.65	27.47		(e)
1.34.33.431	15.45	16.01	16.84	18.26	7.24
1.34.34.143	30.73	31.31	32.04	33.97	
1.34.34.232	27.83	c28.76	29.43	31.66	19.90
1.34.34.321	30.89	31.41	(d)		
1.34.34.411	29.30	29.51	30.15	32.12	20.70
1.34.35.111	26.65	27.20	(d,e)		
1.34.35.121	29.32	(d,e)			
1.34.35.300	26.97	27.62	28.08	30.03	20.06
1.34.36.212				34.89	(e)
h1.34.36.324	31.84	31.22	31.54	33.94	23.05
1.34.36.332	27.53	27.72	27.75		18.94
1.34.36.333				29.76	18.84
1.34.36.421	29.82	30.45	30.20	32.81	
1.34.36.443	29.95	30.11	29.50	32.36	19.37
1.35.2.300	47.63	47.80	48.07	47.84	44.98
1.35.6.141		9.55	10.10	10.70	0.54
1.35.6.400	14.52	14.56	14.90	15.46	5.24
1.35.11.241				20.09	14.26
1.35.19.332	40.55	41.02	41.93	44.41	35.95
1.35.19.432	44.50	(d)	45.60	47.98	44.03
1.35.27.340				35.58	29.50

DEPTH TO WATER, IN FEET BELOW LAND SURFACE DATUM  
1938-1942  
(Continued)

Well location number	Feb. 1938	Jan. 1939	Jan. 1940	Jan. 1941	Jan. 1942
1.35.28.143	51.30	c51.28	50.48	51.49	45.41
1.35.29.111				41.69	35.87
1.35.29.231	39.16	39.28	39.05	40.78	33.90
1.35.30.111	36.46	36.94	37.64	39.68	35.53
1.35.30.212				40.05	(e)
1.35.30.343	28.97	29.98	29.87	32.37	23.06
1.35.31.122	29.34	30.25	29.92	32.73	22.09
1.35.31.231	28.35	29.24	28.50	31.60	21.86
1.35.31.331	28.85	29.35	28.48	31.33	19.31
1.35.31.341	29.20	29.78	(d)		19 72
1.35.31.342	28.68	29.21	28.23	31.15	19.52
1.35.31.421	27.85	28.42	27.48	30.60	18.88
1.35.32.112	26.91	c28.54	27.55	30.52	21.07
1.35.32.212				27.97	19.42
1.35.32.311	25.48	25.97	24.96	27.76	17.41
1.35.32.332	26.58	26.60	25.75	28.35	17.12
1.35.32.411	24.42	24.33	23.30	25.55	14.77
1.35.33.112	30.88	30.39	29.89	31.29	23.13
1.35.33.331	23.66	23.29	22.20	24.03	14.03
1.36.5.300				36.01	33.30
1.36.6.100				40.73	a38.08
1.36.16.100				a23.66	a28.37
2.34.1.114	27.90	27.75	27.73	30.37	18.24
2.34.1.133	27.50	27.14	27.20	29.64	19.18
2.34.1.221	29.59	29.75	29.16	32.00	19.98
2.34.2.233	42.22	42.09	42.12	44.18	33.14
2.34.4.441		3.87	4.70	6.00	k 4.17
2.34.6.321		24.40	25.34	(e)	
2.34.6.412	21.03	21.58	22.68		
2.34.6.421		18.90	20.00	(e)	
2.34.10.343	35.70	35.64	35.50	36.03	33.14
2.34.11.122				30.56	19.20
2.34.12.143		18.09	18.17		9.27
2.34.12.231	11.95	10.98	(d)		
2.34.13.111		17.32	17.42		8.56
2.34.13.224				9.74	1.25
2.34.14.113	30.15	29.03	29.04	30.34	20.56
2.34.14.122					6.10
2.34.14.412	27.53	25.47	25.61	26.81	17.33
2.34.14.443	36.40	35.87	35.66	36.74	29.22
2.34.15.212	31.84	31.60	30.99	32.10	24.68
2.35.2.242	25.35	(b)			
2.35.4.111	23.83	c23.15	22.10	24.08	12.94
2.35.5.311	23.48	23.54	23.10	25.21	12.87

DEPTH TO WATER, IN FEET BELOW LAND SURFACE DATUM  
1938-1942  
(Continued)

Well location number	Feb. 1938	Jan. 1939	Jan. 1940	Jan. 1941	Jan. 1942
2.35.5.341	26.00	c24.05	23.56	25.45	13.45
2.35.5.343	22.26	22.25	(e)		
2.35.6.121	27.52	27.79	26.85	29.81	16.73
2.35.5.213	27.47	27.46	26.66	29.50	16.87
2.35.6.312	25.67	25.36	24.95	27.64	14.45
2.35.6.331		23.08	23.03	25.11	12.96
2.35.6.411		25.15	24.75	27.41	14.25
2.35.6.443	23.97	c23.37	23.35	25.39	13.10
2.35.7.134	33.34	33.00	33.11	34.35	24.01
2.35.7.311	16.38	15.74	15.82	17.03	7.04
2.35.8.331	27.30	26.75	26.75	27.86	18.28
2.35.9.211		18.94	18.37	19.75	10.26
2.35.10.211				19.52	10.30
2.35.14.313		10.04	10.62	11.21	6.79
2.35.14.414			2.86	3.44	k 0.02
2.35.15.131		2.39	2.29	2.76	k 0.02
2.35.16.333		7.46	8.02	8.51	4.12
2.35.18.211		4.34	4.72	5.43	
2.35.19.134	30.97	29.59	28.92		24.68
2.35.25.123	22.96	20.98	22.17	23.22	16.67
2.35.26.111				32.98	28.07
2.36.8.432		18.79	19.60	20.94	13.26
2.36.9.431		20.09	20.59	21.63	15.92
2.36.18.341	16.89	c14.75	15.80	16.83	9.42
2.36.19.113				22.96	16.93
2.36.20.321	14.90	13.72	14.94	15.84	8.12
2.36.21.432		14.44	15.87	16.96	
2.36.24.322	17.60	16.24	16.72		
2.36.25.112		14.82	15.42	16.50	8.13
2.36.26.131	14.07	11.46	12.93	14.12	5.29
2.36.26.311	13.00	10.92	12.24	18.46	5.09
2.36.26.423				16.09	8.15
2.36.27.111				15.47	6.27
2.36.27.131	14.97	12.97	14.35		6.54
2.36.27.211	14.14	11.90	13.45	14.63	5.58
2.36.27.311	15.29	13.32	14.67	15.86	7.04
2.36.38.114b	15.69	13.92	15.13	16.30	7.53
2.36.28.411	15.34	13.47	14.76	15.96	7.06
2.36.28.421	16.42	14.59	15.89	17.05	8.26
2.36.28.441	17.18	15.30	16.58	17.74	
2.36.30.111					0.70
2.36.34.111	16.02	14.17	15.40	16.59	8.18
2.36.34.221	10.07	c 8.74	9.88	11.01	4.01
2.36.34.341	19.54	17.95	18.82	19.97	12.39

DEPTH TO WATER, IN FEET BELOW LAND SURFACE DATUM  
1938-1942  
(Continued)

Well location number	Feb. 1938	Jan. 1939	Jan. 1940	Jan. 1941	Jan. 1942
2.36.34.421		8.58	9.48	10.64	4.24
2.36.35.212	10.75	8.32	9.25	10.40	3.81
2.37.19.331		18.64	19.28	20.19	12.74
2.37.19.341		18.25	19.00	19.84	12.97

- a Windmill pumping.
- b Well filled.
- c Previous measuring point destroyed; new measuring point could not be accurately referenced to old. Possible discrepancy of several tenths of a foot between preceding and succeeding record.
- d Unable to measure.
- e Measurements discontinued.
- f Pump stopped 1½ hours previous to measurement
- h Formerly well 1.34.36.233.
- k Water level in feet above land surface datum.

### CONCLUSIONS

The record shows that from 1932 to 1941 the water levels in the pumped area of the Portales Valley fell gradually and almost constantly, but that in 1941 they rose in many wells to unprecedented levels. The lowering of the water table that occurred between 1932 and the end of 1940 was caused chiefly by pumping; the great rise in 1941 was caused directly or indirectly by the excessive rainfall of that year.

The rise of the ground-water levels during 1941 is very encouraging, as it has shown that a large quantity of water is added to the ground-water reservoir during years of exceptional rainfall. However, it should be remembered that the rainfall in the eastern part of the State in 1941 was the highest ever recorded. At Portales it was the highest during the period of record of 33 years, and at Roswell, about 90 miles southwest of Portales, it was highest during a period of record of 64 years. There will probably not be many years in a century during which the rainfall in the area will be comparable to that in 1941, and such large rises in the ground-water levels can therefore be expected only at long intervals.

The irrigated area in the valley has increased rapidly in the last few years, but as much of the increase has been for crops of low water requirement, the irrigation pumpage has not increased proportionally. Planting of a large part of this land to crops of high water requirement would cause greater use of water and more rapid lowering of the water levels and depletion of the water supply.

The present irrigation development in the heavily pumped areas near Portales is probably as great as it should be for proper utilization of the ground-water supply. New developments might be undertaken in the outlying districts where pumping is not very intensive at the

present time and where the water is near the surface, but even such additional development should be seriously considered, as the additional draft will affect the water levels over the whole valley in the long run. No new development should be undertaken solely because of the very encouraging water-supply prospects resulting from the water-level rise during 1941.